

U.S. DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER  
33942R003

U.S. APPLICATION NO. (if known,  
see 37 CFR 1.5)

10/088233

INTERNATIONAL APPLICATION NO.  
PCT/BR00/00105

INTERNATIONAL FILING DATE  
September 20, 2000

PRIORITY DATE CLAIMED  
September 20, 1999

TITLE OF INVENTION

A METHOD FOR CONTROLLING AND PROTECTING ELECTRIC MOTORS, A SYSTEM FOR  
CONTROLLING ELECTRIC MOTORS AND AN ELECTRIC MOTOR SYSTEM

APPLICANT(S) FOR DO/EO/US

Paulo Sergio Dainez; Luiz Von Dokonal and Marcos Guilherme Schwarz.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ has been transmitted by the International Bureau (**see accompanying PCT Form 308**).
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2))
7. ☒ Amendments to the claims of the International Application under PCT Article 34 (35 U.S.C. 371).
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau
  - c. ☐ have not been made, however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 34 (35 U.S.C. 371)
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment
  - ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
  - a. PCT Publication WO 01/22566 with International Search Report (PCT/ISA/210)
  - b. PCT Request (Form PCT/RO/101)
  - c. Notification of Transmittal of the International Search Report or the Declaration (Form PCT/ISA/220)
  - d. International Preliminary Examination Report (Form PCT/IPEA/409 and PCT/IPEA/416)
  - e. PCT Demand (Form PCT/IPEA/401)



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PATENT TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

JC18 Rec'd PCT/PTO 19 MAR 2002

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)

10/088233

17. ☒ The following fees are submitted:

CALCULATIONS

PTO USE ONLY

**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO or JPO ..... \$890.00

International preliminary examination fee paid to USPTO

(37 CFR 1.482) ..... \$710.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$740.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$1,040.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT = \$890.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.495(e))

\$ ---

Claims	Number Filed	Number Extra	Rate		
Total Claims	7 - 20 =	0	x \$18.00		
Independent Claims	3 - 3 =	0	x \$84.00		
Multiple dependent claim(s) (if applicable)			+ \$280.00	.00	

TOTAL OF ABOVE CALCULATIONS = \$ 890.00

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).

\$ .00

SUBTOTAL = \$ 890.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f))

+

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TOTAL NATIONAL FEE = .890.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

+

\$ .00

TOTAL FEES ENCLOSED = \$890.00

Amount to be refunded \$

charged \$

a. ☒ A check in the amount of \$890.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$\_\_\_\_\_ to cover the above fees.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4300.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

**SEND ALL CORRESPONDENCE TO:**

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SIGNATURE

Dennis C. Rodgers, Reg. No. 32,936

NAME

REGISTRATION NO.

Date: March 19, 2002

33942R003

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Paulo Sergio Dainez, et al.

International Application No.: PCT/BR00/00105

International Filing Date: September 20, 2000

U.S. Serial No.: To Be Assigned

Group Art Unit: To Be Assigned

Filed: : March 19, 2002 (Herewith)

Examiner: To Be Assigned

For: A METHOD FOR CONTROLLING AND PROTECTING ELECTRIC MOTORS,  
A SYSTEM FOR CONTROLLING ELECTRIC MOTORS AND AN ELECTRIC  
MOTOR SYSTEM

**PRELIMINARY AMENDMENT**

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Prior to or concurrent with calculation of the filing fees, please amend this application as follows.

**IN THE CLAIMS**

Applicants have attached to this Amendment documents entitled "Amended Claims" and "Marked-Up Copy of Previous Claims". Please amend claims 4 as shown in the document entitled "Marked-Up Copy of Claims". Please add new claim 7 as shown in the document entitled "Amended Claims".


**REMARKS**

Entry and consideration of this Preliminary Amendment is respectfully requested prior to or concurrent with calculation of the filing fees. This Preliminary Amendment is being filed to remove the multiple dependent claims to avoid the surcharge.

Examination on the merits is awaited.

Respectfully submitted,

SMITH, GAMBRELL & RUSSELL, LLP

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March 19, 2002

MARKED UP COPY OF CLAIMS

4. (Amended) The method in accordance with claim 2 [or 3] characterized in that the control system 2 may be turned off through said error signal.



4. (Amended) The method in accordance with claim 2 characterized in that the control system 2 may be turned off through said error signal.

7. (New) The method in accordance with claim 3 characterized in that the control system 2 may be turned off through said error signal.



Title: "A METHOD FOR CONTROLLING AND PROTECTING ELECTRIC MOTORS,  
A SYSTEM FOR CONTROLLING ELECTRIC MOTORS AND AN ELECTRIC  
MOTOR SYSTEM"

**Disclosure of the invention**

5           The present invention is directed to a method for controlling and protecting electric motors, specially permanent magnet motors electronically actuated by a control system comprising a three-phase inverting bridge, in which it is required to monitor the position of the rotor by using a position detector physically attached to the axle or through the tension induced in the coils by the magnet, in order to  
10       correctly control actuation by the control system. The present invention is also directed to a system for controlling electric motors and an electric motor system.

          The objective of the present invention is to prevent one or more switches of the three-phase inverting bridge from being actuated at an improper time, what can lead to the generation of high currents which cannot be detected by the current  
15       detector, said currents may cause the auto-demagnetization of the rotor magnet, besides causing damages to the switches of said inverting bridge.

**Description of the State of the Art**

          The detection of the rotor position is required for the actuation of permanent magnet motors.

20           In accordance with the prior art to the present invention, such detection can be accomplished through sensors physically connected to the rotor ("hall", optical type, and the like) or by observing the voltages induced in the motor coils themselves, as described in Brazilian Patent Application PI 8805485, in such a way that the control may correctly select which phases of the motor will be activated every time.

25           As described in more details below, the control unit, when normally operating, analyzes the input of the position detector and current protection detector, thus activating the respective outputs in accordance with a predetermined table. However, if there is a failure in the position detector, it is likely that one or more switches of the three-phase inverting bridge is unduly activated, the result of which  
30       can be the generation of high currents that are not detected by the current detector, thus resulting in the auto-demagnetization of the motor magnet and damages to the switches of the three-phase inverting bridge.

          As known, the demagnetization of the magnet makes it difficult to start the

motor, decreases the output and overheats the motor, being inadmissible in all the cases.

Still according to the prior art to this invention, the following measures to prevent the auto-demagnetization of the motor magnet are adopted: the design of a more robust motor, with an increased magnet thickness, what would increase notably the cost, specially in view of a larger magnet; the installation of a current protection detector in every switch or every phase of the motor, what would not only increase the cost but also the complexity of the system, by virtue of the higher number of detectors and signals for the control to analyze; or the simple elimination of the protection against auto-demagnetization, thus placing the integrity of the motor under the statistical possibility of the occurrence of a failure, what represents a serious risk not only for the system, but also for the image of the manufacturer.

#### **Brief Description and Objects of the Invention**

After a number of investigations, it was evidenced that, when normally operating and following the same rotation direction, the sequence where the positions of the rotor are updated in the sensor is always the same. Thus, such sequence can be predetermined, whereby the control unit of the system for controlling an motor could foresee the sequence where the positions of the rotor will be changed. By knowing the speed the motor is rotating at, it is possible to foresee the time when the position of the rotor will be changed.

With these information, the control unit can prevent failures when the motor is actuated, thus assuring the integrity of the rotor magnet and the inverting bridge switches.

In accordance with the teachings of the present invention, the control unit will accept only the position foreseen for the applicable rotation direction as valid, and always at the time expected for the present speed.

Preferably, when determining this time, a tolerance range defining a minimum time and a maximum time, during which a change in the position should take place, should be considered.

The present invention has the advantages, compared to the prior art, that it is not necessary to any oversize the rotor magnet, the cost and the complexity of the motor are decreased, and the current protection detector is simplified, besides conferring a greater reliability to the system.

Such advantages are attained through a method for controlling and protecting

electric motors provided with a rotor, specially permanent magnet motors electronically actuated by a control system comprising a three-phase inverting bridge, characterized by comprising the step of counting a first period of time, during which said rotor should be between an original position and the next position, and the step  
5 of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position.

The present invention is also expressed as a system for controlling an electric motor provided with a rotor, specially a permanent magnet motor, comprising a three-phase inverted bridge and characterized by being additionally comprised of a  
10 microcontroller capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out the step of counting a first period of time, during which said rotor should be between an original position and the next position, and the step of counting a second period of time subsequent said first period of time, during which said rotor should pass through said next position, as well  
15 as an electric motor system comprising a control system, an electric motor electronically actuated by the control system, and characterized by being additionally comprised of a microcontroller capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out the step of counting a first period of time, during which said rotor should be between an original  
20 position and the next position, and the step of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position.

### Brief Description of the Drawings

The present invention will be described below in more details with reference to  
25 the accompanying drawings, wherein:

Figure 1 represents a block diagram of an electric motor system electronically actuated by a control system;

Figure 2 is a schematic representation of a three-phase inverting bridge;

Figure 3 is a three-phase inverting bridge actuation table; and

30 Figure 4 is a generic flowchart of a method for controlling and protecting electric motors that incorporates the teachings of this invention.

### Detailed Description of the Invention

With reference to Figures 1 and 2, an electric motor system 1 is electronically actuated by a control system 2 comprising a rectifying bridge 3 basically, a capacitive

filter 4, a three-phase inverting bridge 5, a three-phase motor provided with a permanent magnet rotor 10, a control unit 11, position detectors SA, SB and SC, and a current protection detector PI.

As known in the state of the art, the control unit 11 is responsible for the monitoring of the position detectors SA, SB and SC and the current protection detector PI in order to excite, through the respective outputs, the switches T1 through T6 of the three-phase inverting bridge 5 at a suitable time in accordance with the table illustrated in Figure 3.

Thus, in response to the command of the control unit 11, the three-phase inverting bridge 5 will also apply a current to the coils of the motor 10 at the right time.

As already mentioned, in the event there is any failure in the position detectors SA, SB and SC, it is possible that one or more switches T1 through T6 of the three-phase inverting bridge 5 is not properly activated, what can generate high currents that are not detected by the current protection detector PI, resulting in the auto-demagnetization of the motor and damages to the switches T1 through T6 of the three-phase inverting bridge 5.

In accordance with the teachings of the present invention, the control system 2 also includes a microcontroller (not-shown) capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out successive steps of time counting. As known in the art, such counter may be an internal component of said microcontroller.

Said counter is set to zero whenever there is a change in the position of the rotor of the electric motor 10, the counting of a first period of time is started, during which period the rotor should be between a position and another one. Later on, the counting of a second period of time is started, during which time the rotor should pass through the next position.

In a three-phase motor with two poles there are six basic positions P1 through P6 of the rotor as shown in Figure 3, which positions should be successively reached by the rotor during a respective second period of time.

If the rotor passes through one of the positions during said first period of time, what would be too early, or after said second period of time has elapsed, what would be too late, it means that there has been some error, and then said microcontroller turns off the control system 2 in order to prevent further damages, thus preserving

the integrity of the rotor magnet and the switches of the three-phase inverting bridge.

If the rotor pass through the correct position during said second period of time, the microcontroller will issue an output updating signal and restart the counter, preparing same for counting the first and second periods of time corresponding to the next position where the rotor should pass through.

Of course, if the rotor, during said second period of time, passes through a position that is not the correct one, it also means that there has been some error, and then said microcontroller turns off the control system 2.

Figure 4 represents a generic flowchart of a method for controlling and protecting electric motors to exemplify the present invention.

In accordance with the specific teachings of this invention, said second period of time should include a tolerance for the moment the rotor passes through a given position. As an example, in a three-phase motor with two poles rotating at 3,000 rpm, the rotor takes 20 ms to complete one turn, and thus it shall consume 3.3 ms for passing through each position.

In order to come up with said tolerance, said second period of time measured by the counter should include a first head range of  $1.65 \text{ ms (x/2)}$  and a second tail range of  $6.6 \text{ ms (2x)}$  beyond the regular  $3.3 \text{ ms}$ , what represents a tolerance of  $x-50\%$  and  $x+100\%$ .

After a preferred example of realization has been described, it should be understood that the scope of the present invention encompasses other possible variations, being limited only by the contents of the appended claims including the possible equivalents.

## CLAIMS

1- A method for controlling and protecting electric motors (10) provided with a rotor, specially permanent magnet motors electronically actuated by a control system (2) comprising a three-phase inverting bridge (5), characterized by comprising a step  
5 of counting a first period of time, during which said rotor should be between an original position and the next position and a step of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position.

2- The method in accordance with claim 1, characterized by comprising an  
10 additional step of issuing an error signal if said rotor passes through said next position before or after said second period of time, or an output updating signal to restart a counter in the event the rotor passes through said next position during said second period of time.

3- The method in accordance with claim 2, characterized by comprising an  
15 additional step of issuing an error signal if said rotor passes, during said second period of time, through a position other than the one that follows said original position.

4- The method in accordance with claim 2 or 3 characterized in that the control system 2 may be turned off through said error signal.

20 5- A control system (2) for an electric motor (10) provided with a rotor, specially a permanent magnet motor, comprising a three-phase inverting bridge (5) and characterized by being additionally comprised of a microcontroller capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out the step of counting a first period of time, during  
25 which said rotor should be between an original position and the next position, and the step of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position.

6- An electric motor system 1 comprising a control system (2), an electric motor (10) electronically actuated by the control system 2, and characterized by  
30 being additionally comprised of a microcontroller, capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out the step of counting a first period of time, during which said rotor should be between an original position and the next position, and the step of counting a second

period of time that follows said first period of time, during which said rotor should pass through said next position.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



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PCT

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(81) Designated States (national): **CN, JP, KR, SG, TR, US.**

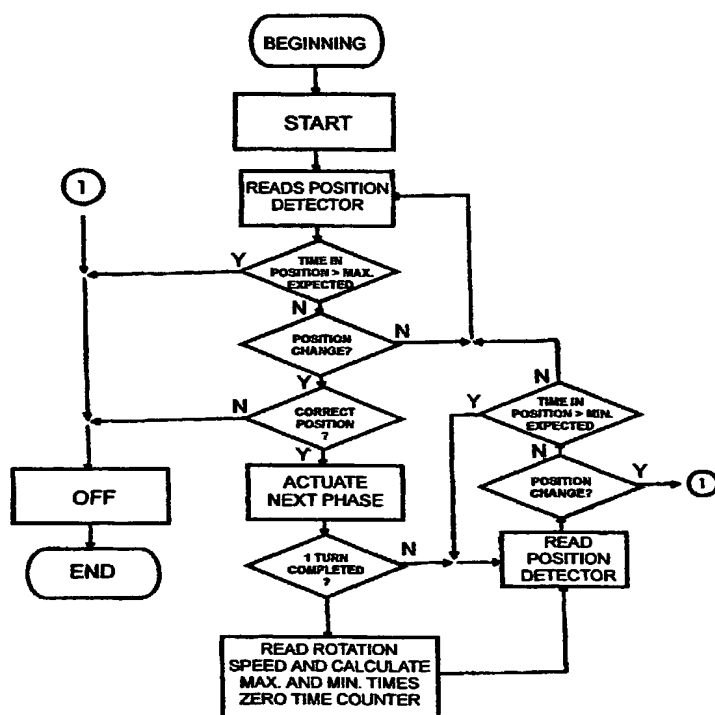
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CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,  
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**Published:**

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

[Continued on next page]

(54) Title: **A METHOD FOR CONTROLLING AND PROTECTING ELECTRIC MOTORS, A SYSTEM FOR CONTROLLING ELECTRIC MOTORS AND AN ELECTRIC MOTOR SYSTEM**

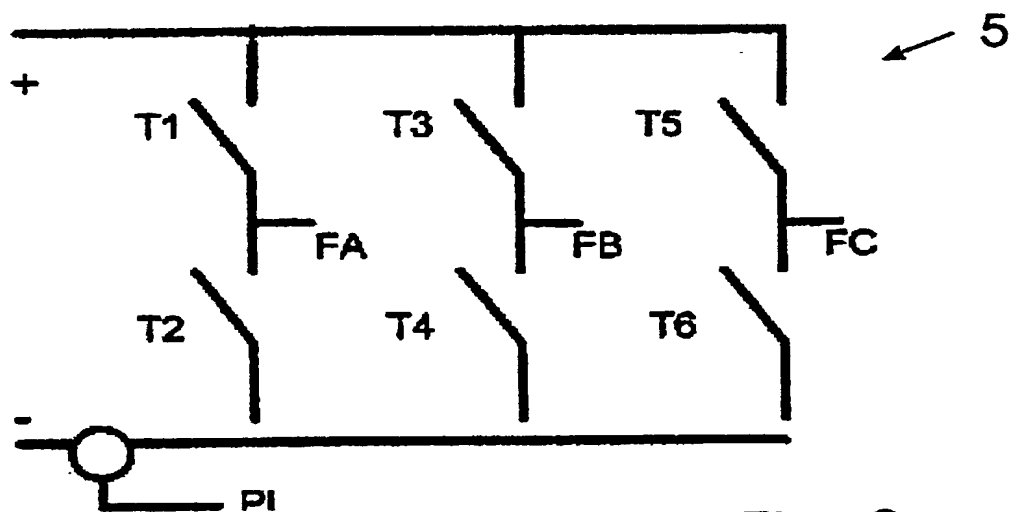
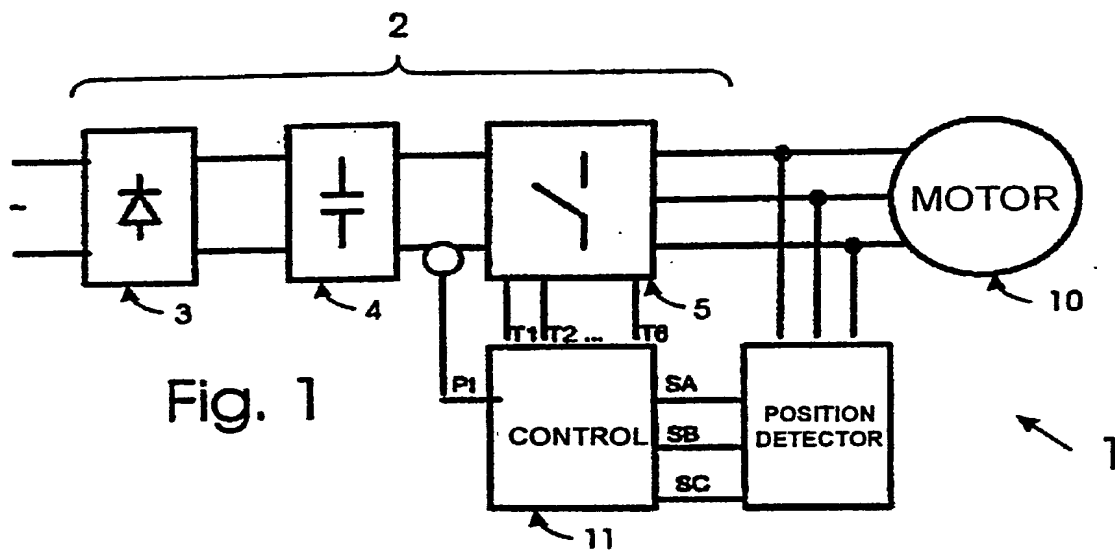


(57) Abstract: A method for controlling and protecting electric motors (10) provided with a rotor, specially permanent magnet motors electronically actuated by a control system (2) comprising a three-phase inverting bridge (5), characterized by being comprised of the step of counting a first period of time, during which said rotor should be between an original position and the next position, and the step of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position. The present invention is also expressed as a control system (2) for an electric motor (10) provided with a rotor, specially a permanent magnet motor, comprising a three-phase inverting bridge (5) and characterized by being additionally comprised of a microcontroller capable of analyzing the positions of the rotor as a function of the time, associated with a counter capable of carrying out the step of counting a first period of time, during which said rotor should be between an original position and the next position, and the stage of counting a second period of time that follows said first period of time, during which said rotor should pass through said next position, as well as an electric motor (1) comprising the control system (2).

WO 01/22566 A1



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POSITION N.	INLET				OUTLET					
	POSITION DETECTOR			CURRENT /PI	SWITCH ACTUATION					
	SA	SB	SC		T6'	T5'	T4'	T3'	T2'	T1'
P1	1	0	1	0	0	0	1	0	0	1
P2	1	0	0	0	1	0	0	0	0	1
P3	1	1	0	0	1	0	0	1	0	0
P4	0	1	0	0	0	0	0	1	1	0
P5	0	1	1	0	0	1	0	0	1	0
P6	0	0	1	0	0	1	1	0	0	0
X	X	X	X	1	0	0	0	0	0	0

Fig. 3

3/3

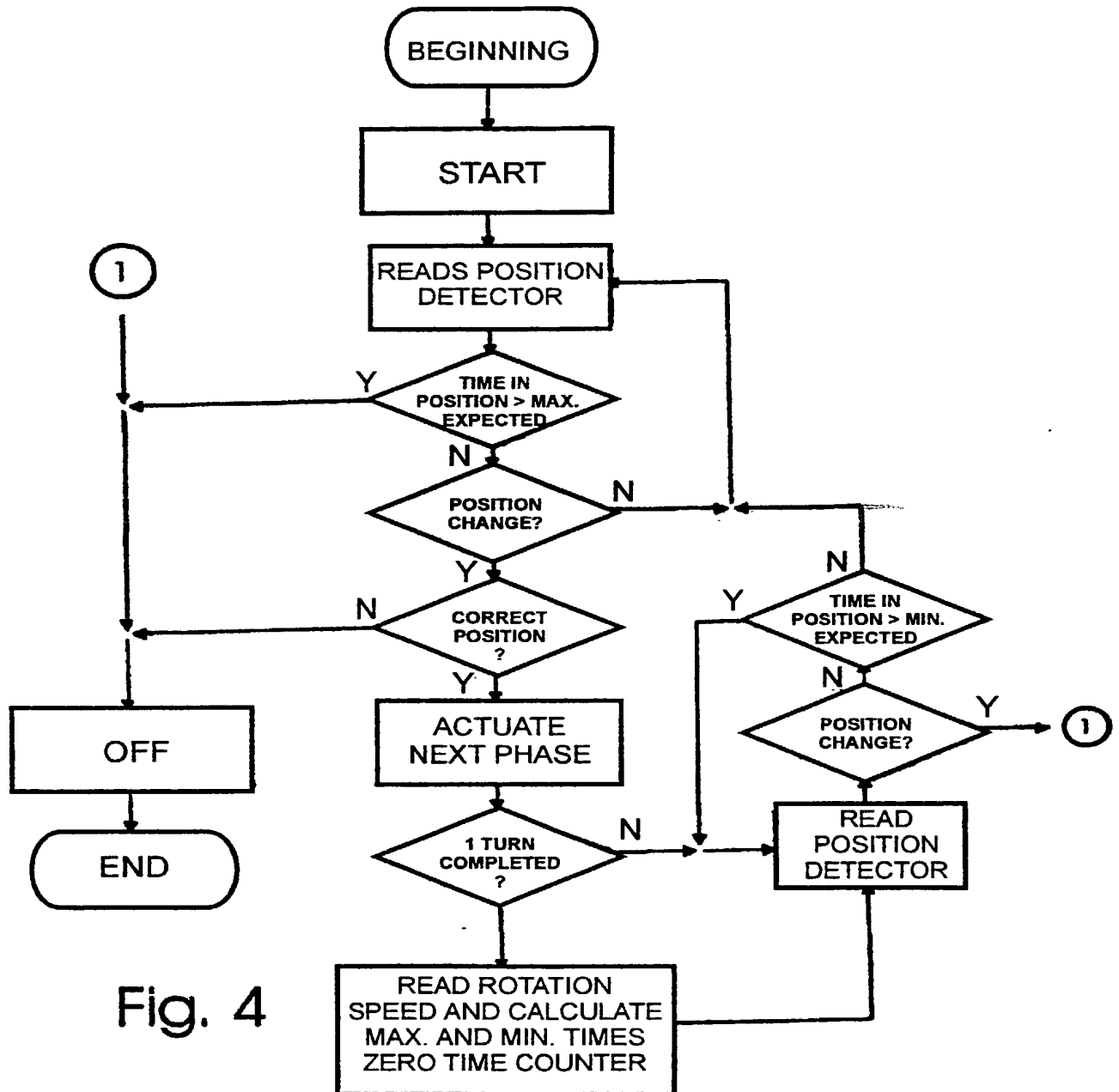


Fig. 4

# Declaration and Power of Attorney United States Patent Application

UNITED STATES  
Patents and Design Patents  
Sole & Joint Inventors  
Convention & Non-convention  
PCT & Non-PCT  
This form cannot be amended, altered  
or changed after it is signed  
(For use only for inventors who  
understand the English language.)

As a below named inventor, I hereby declare that:  
My residence, post office address and citizenship are as stated below next to my name.  
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor  
(if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention  
entitled:

(check one) ☐ is attached hereto.  
☒ was filed as U.S. Application No. 10/088,233 on March 19, 2002 and (if applicable)  
was amended on \_\_\_\_\_ and filed on \_\_\_\_\_  
☒ was filed as PCT International Application No. PCT/BR00/00105 on September 20, 2000 and (if applicable)  
was amended under PCT Article 34 on \_\_\_\_\_.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.  
I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign and PCT application(s) for patent or inventor's  
certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America listed in this Declaration.  
I have also identified below any foreign application for patent or inventor's certificate or PCT international application having a filing date before that of the  
application(s) on which priority is claimed:

Foreign/PCT Application No.	Country	Filing Date	Priority Claimed? (yes/no)
PI 9904253-3	Brazil	September 20, 1999	yes

I hereby claim the benefit under Title 35, United States Code, §120 or §365(e) of any United States application and PCT international application designating the  
United States of America listed in this Declaration and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States  
application or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose  
information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior  
application and the national or PCT international filing date of this application:

U.S. Application No.	Filing Date	Status (patented/pending/abandoned?)

I hereby claim priority benefits under Title 35 United States Code §119(e) of any U.S. provisional application(s) listed below:

U.S. Provisional Application No.	Filing Date

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Robert G.  
Weilacher (20,531), Herbert M. Hanegan (25,682), Dale Lischer (28,438), Frederick F. Calvetti (28,557), J. Rodgers Emsford, III (29,405), Michael A. Makuch  
(32,263), Dennis C. Rodgers (32,936), Mary A. Montebello (33,021), Eric J. Hanson (44,738), Patrick R. Delaney (45,338), Brandon S. Boss (46,567), and Brett L.  
Nelson (48,119).

Send all correspondence to: SMITH, GAMBRELL & RUSSELL, LLP, 1850 M Street, N.W. (Suite 800), Washington, D.C. 20036. All facsimiles may be sent to (202)  
263-4329. Direct all phone calls to (202) 659-2811.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to  
be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or  
both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued  
thereon.

Full name of sole or first inventor: PAULO SERGIO DAINBZ  
Residence (city, state, country): Joinville, SC  
Post office address: Rua Rui Barbosa, 1431 - apto 302  
Bloco I  
Joinville, SC, Brazil  
Signature: Paulo Sergio DainbZ

Citizenship: Brazilian

Date: 06/11/02

Full name of second joint inventor, if any: LUIZ VON DOKONAL  
Residence (city, state, country): Joinville, SC, Brazil  
Post office address: Rua Visconde de Mauá, 241  
Joinville, SC, Brazil  
Signature: Luiz Von Dokonal

Citizenship: Brazilian

Date: 06/07/02

Additional Names Attached

Full name of third joint inventor, if any: MARCOS GUILHERME SCHWARZ Citizenship: Brazilian  
Residence (city, state, country): Joinville, SC, Brazil  
Post office address: Rua General Osorio, 257  
Joinville, SC, Brazil *MSF*

Signature: Michael A. Smerczak

Date: MAY 24, 2002

Full name of fourth joint inventor, if any:  
Residence (city, state, country):  
Post office address:

**Citizenship:**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Full name of fifth joint inventor, if any:  
Residence (city, state, country):  
Post office address:

**Citizenship:**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Full name of sixth joint inventor, if any:  
Residence (city, state, country):  
Post office address:

**Citizenship:**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Full name of seventh joint inventor, if any:  
Residence (city, state, country):  
Post office address:

**Citizenship:**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Full name of eighth joint inventor, if any:  
Residence (city, state, country):  
Post office address:

**Citizenship:**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_